United States Patent [19]

Schmidt

[11] **3,814,153**

[45] **June 4, 1974**

[54] **APPARATUS FOR PERFORMING A SERIES OF OPERATIONS ON A SUCCESSION OF WOOD WORKPIECES**

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July 23, 1971 Austria 6435/71

[52] **U.S. Cl.** ..... **144/3 R,** 144/134 R, 29/33

[51] **Int. Cl.** **B27m 3/18,** B27c 5/02

[58] **Field of Search** ..... 144/3 R, 134 R; 29/33

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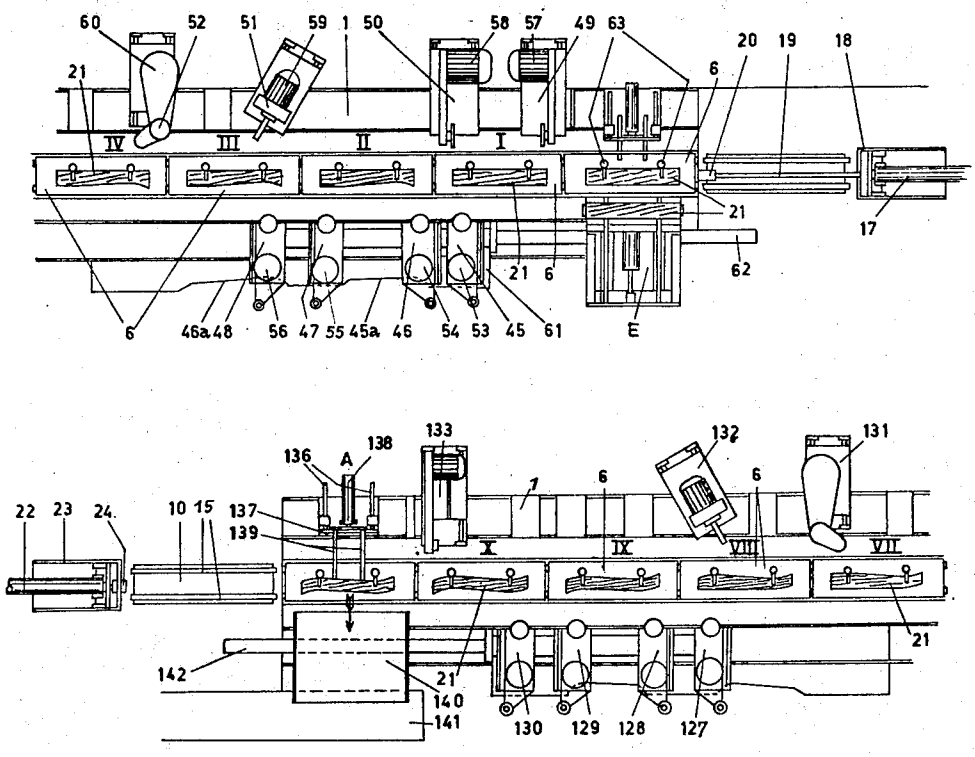
Primary Examiner—Donald R. Schran

Attorney, Agent, or Firm—Karl F. Ross; Herbert Dubno

[57] **ABSTRACT**

A succession of wooden workpieces are each retained on a carriage forming part of a train of carriages pushed stepwise along an upper guide track along which are arranged a plurality of woodworking machines. A workpiece is loaded automatically onto the furthest upstream carriage and prepared as it moves along and is finally removed from its carriage when this carriage reaches the downstream end of the track. The carriage is then turned over and sent upstream to take on a new workpiece. Midway in the working track there is provided an apparatus having two arms each provided with a rotatable head having jaws which grip the workpiece's ends. Then the arms lift and turn the workpiece over and set it back on its carriage so that its other face can be worked on.

11 Claims, 18 Drawing Figures



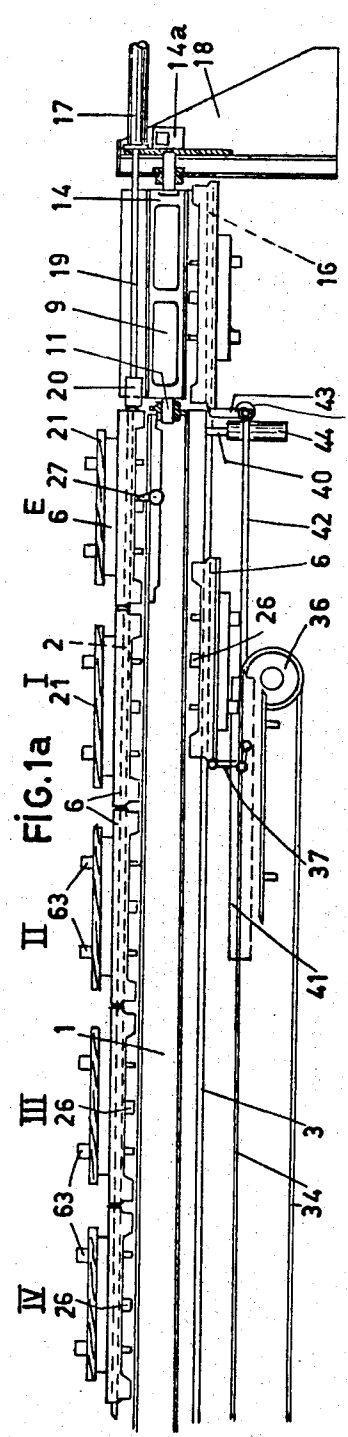

17
14a
18
14
16
19
9
11
20
21
27
6
E
43
43a
44
40
42
36
26
2
I
21
6
37
63
II
41
1
III
3
34
IV

FIG.1a

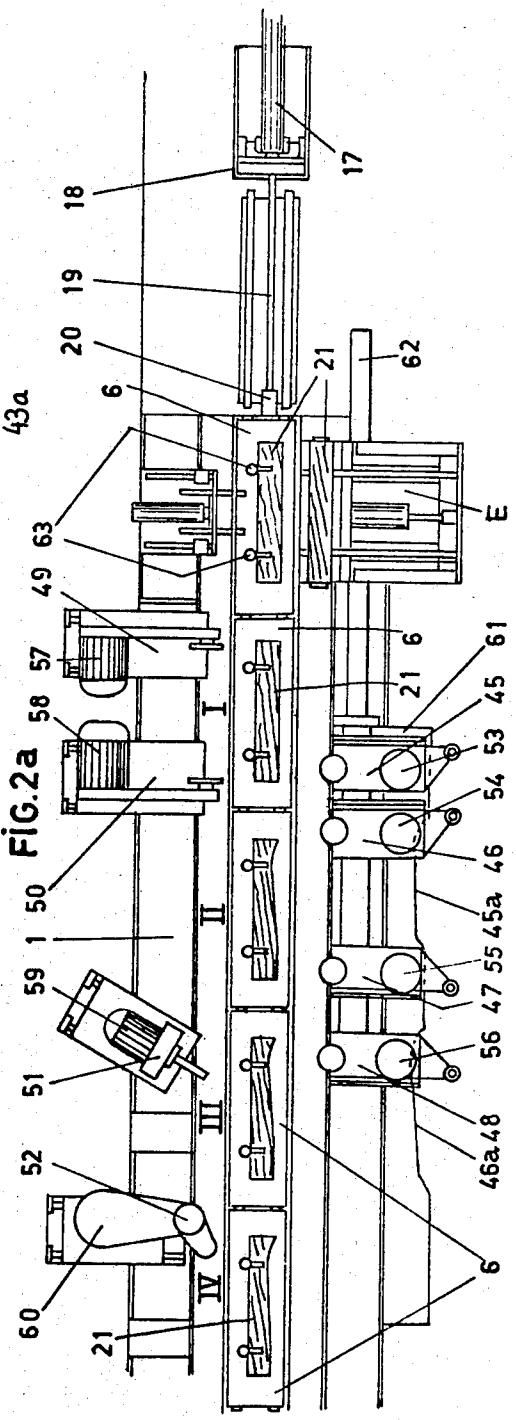
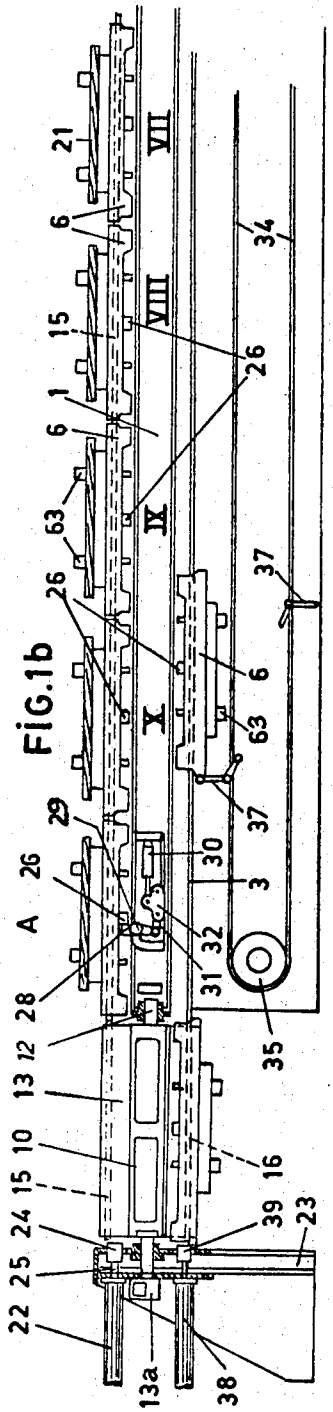
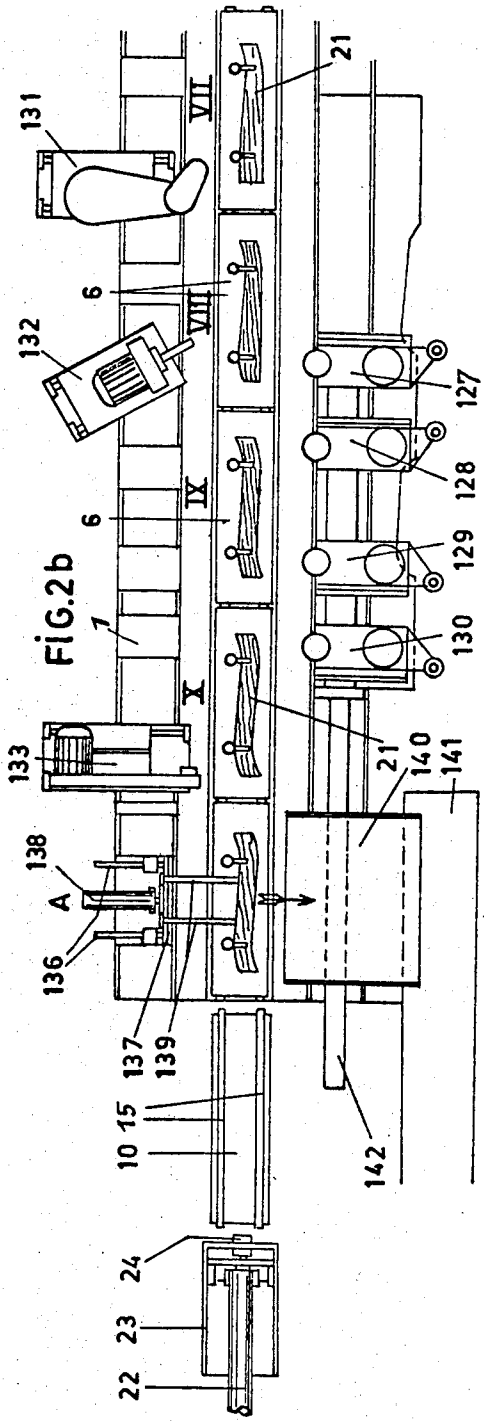

18
17
19
20
21
62
6
E
63
49
57
58
I
61
45
53
54
50
46
II
1
45a
59
55
47
51
III
56
48
46a
52
6
60
IV
21

FIG.2a


FIG.1b
VII
VIII
IX
X
A
21
6
15
1
63
26
29
30
3
31
32
28
12
13
10
15
24
25
22
13a
16
39
23
38
34
37
35


FIG.2b
131
132
133
138
A
136
137
139
10
15
24
23
22
VII
VIII
IX
X
1
6
21
127
128
129
130
140
141
142

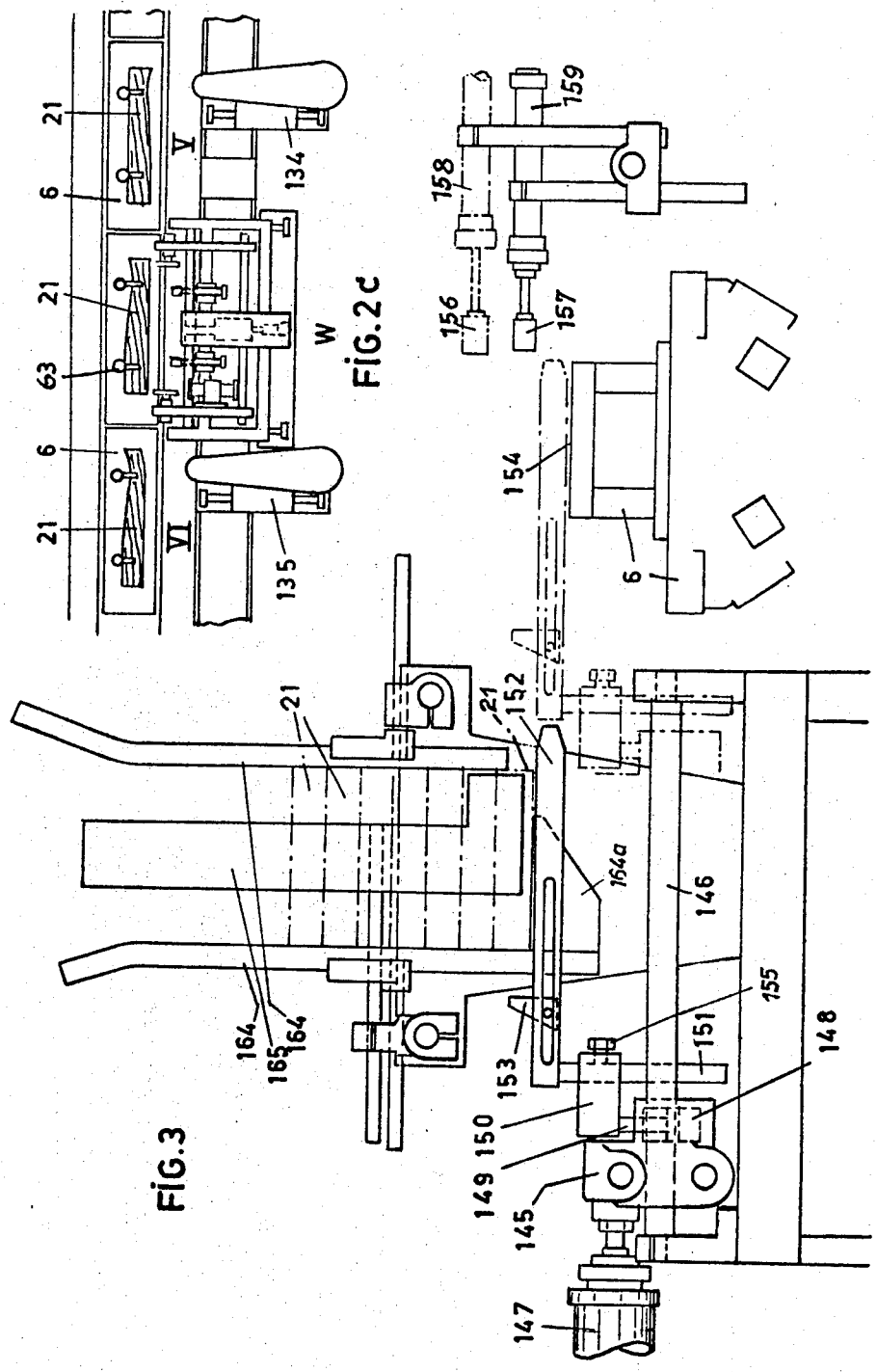

21
6
21
63
6
21
V
VI
134
135
W
159
158
156
157
154
6
21
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152
164a
146
155
151
148
164
165
164
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149
150
145
147

FIG.2c

FIG.3

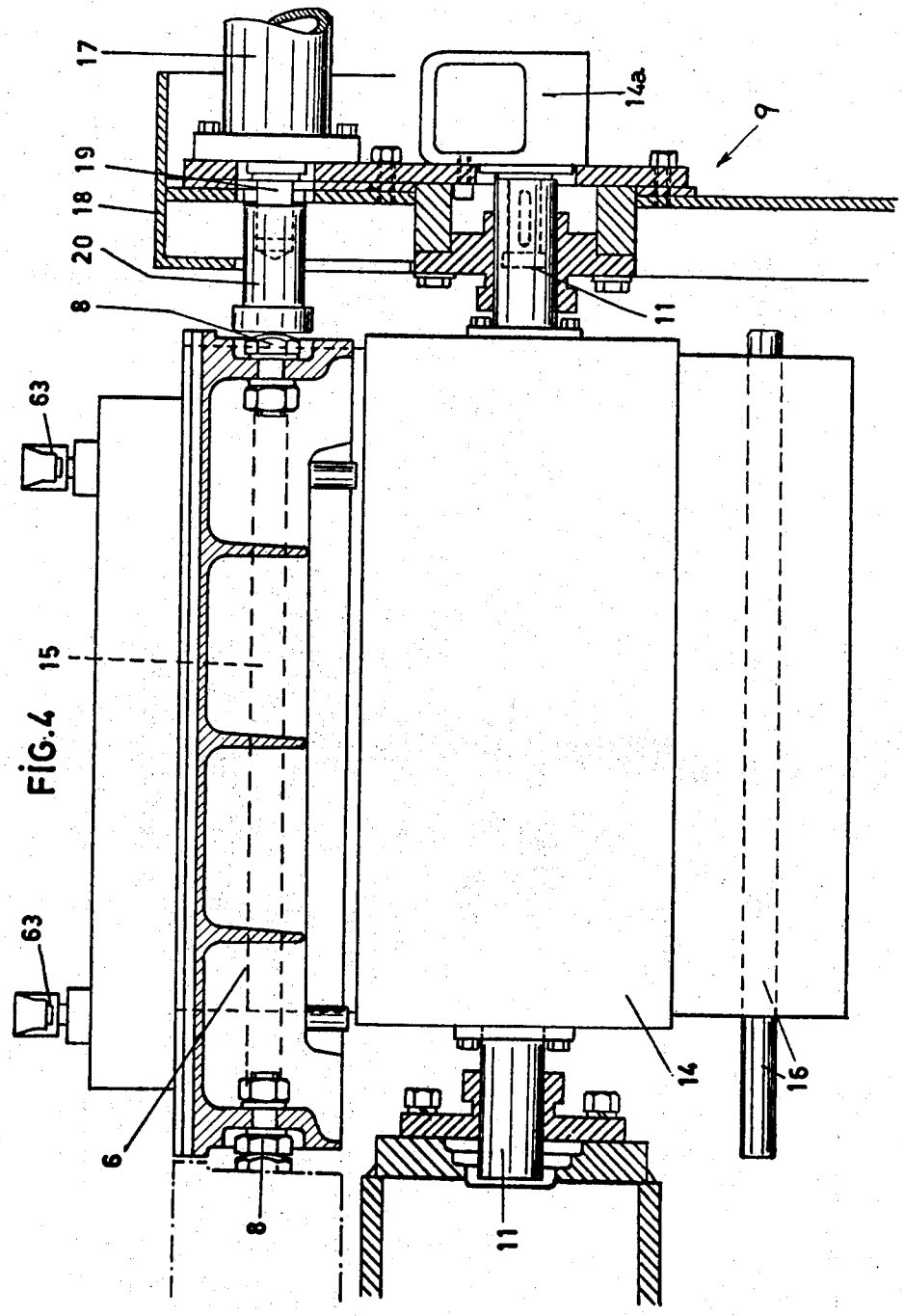


FIG.4

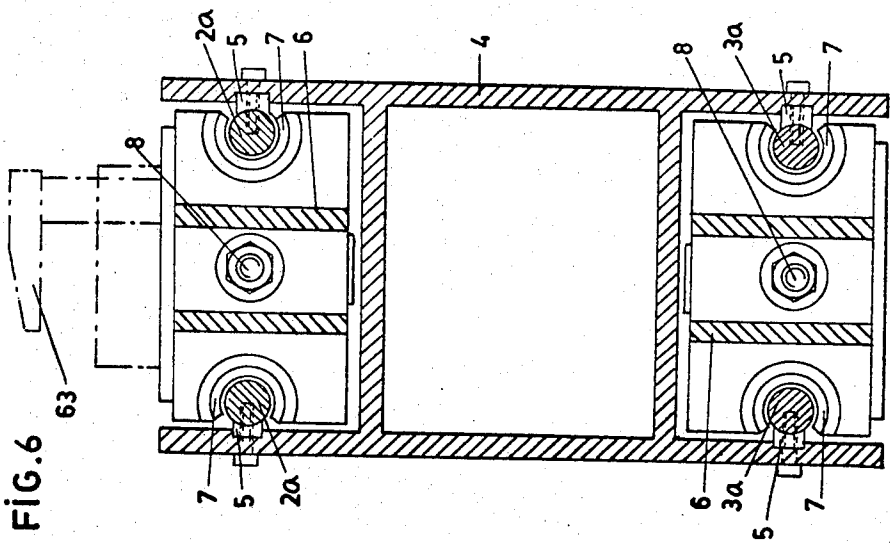

2a
5
7
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8
3a
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7
8
63
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2a
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3a
5
7

FIG.6

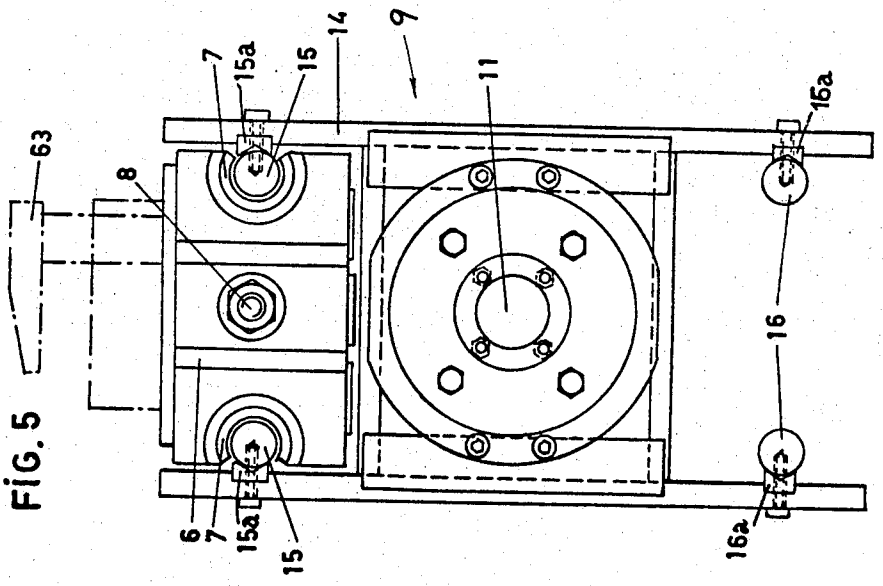

7
15a
15
14
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16a
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16a

FIG.5

FIG.7

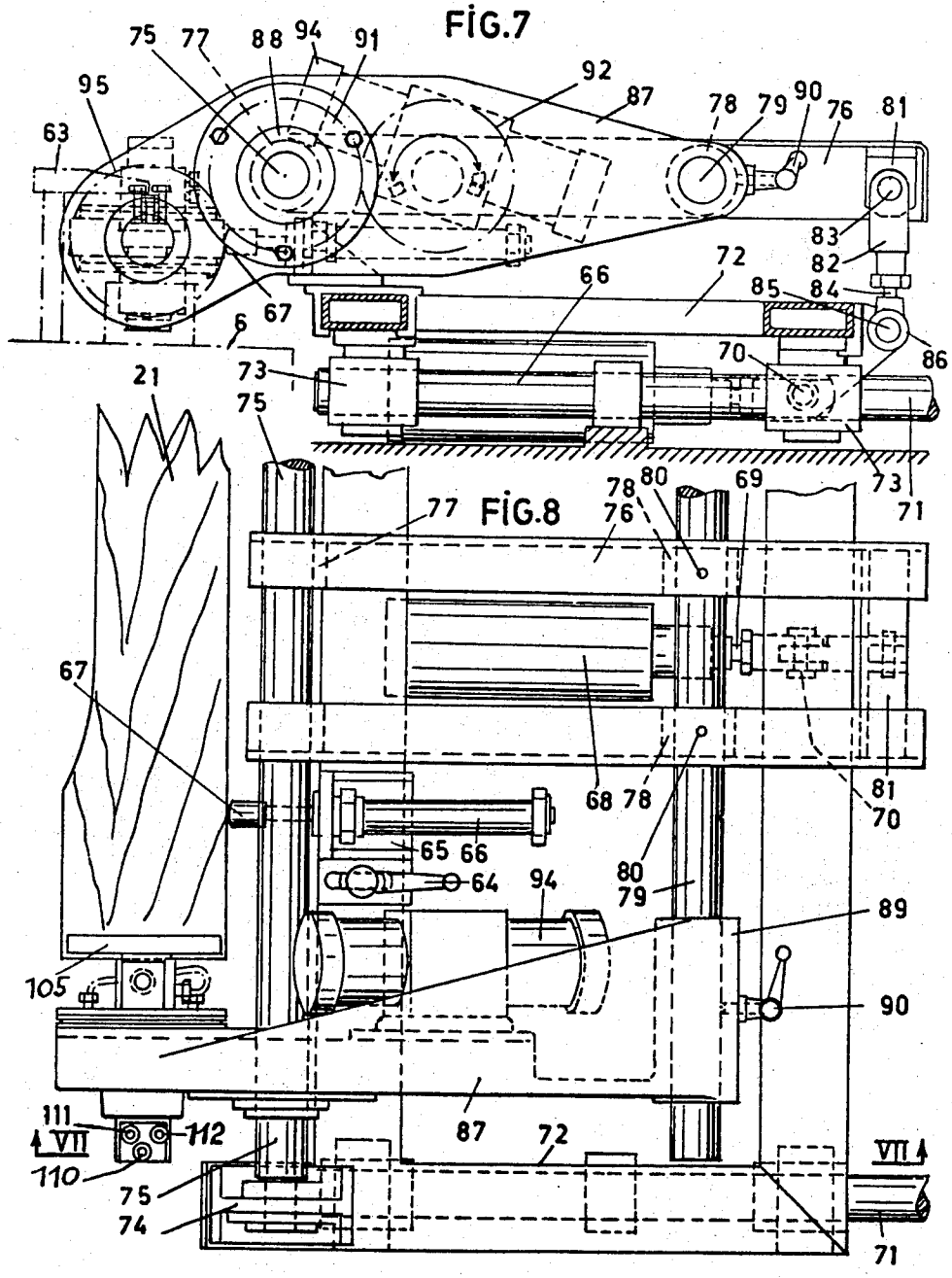

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FIG.8

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73
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67
68
78
81
70
65
66
64
94
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79
89
105
90
111
VII
112
110
75
74
87
72
VII
71

FIG.9

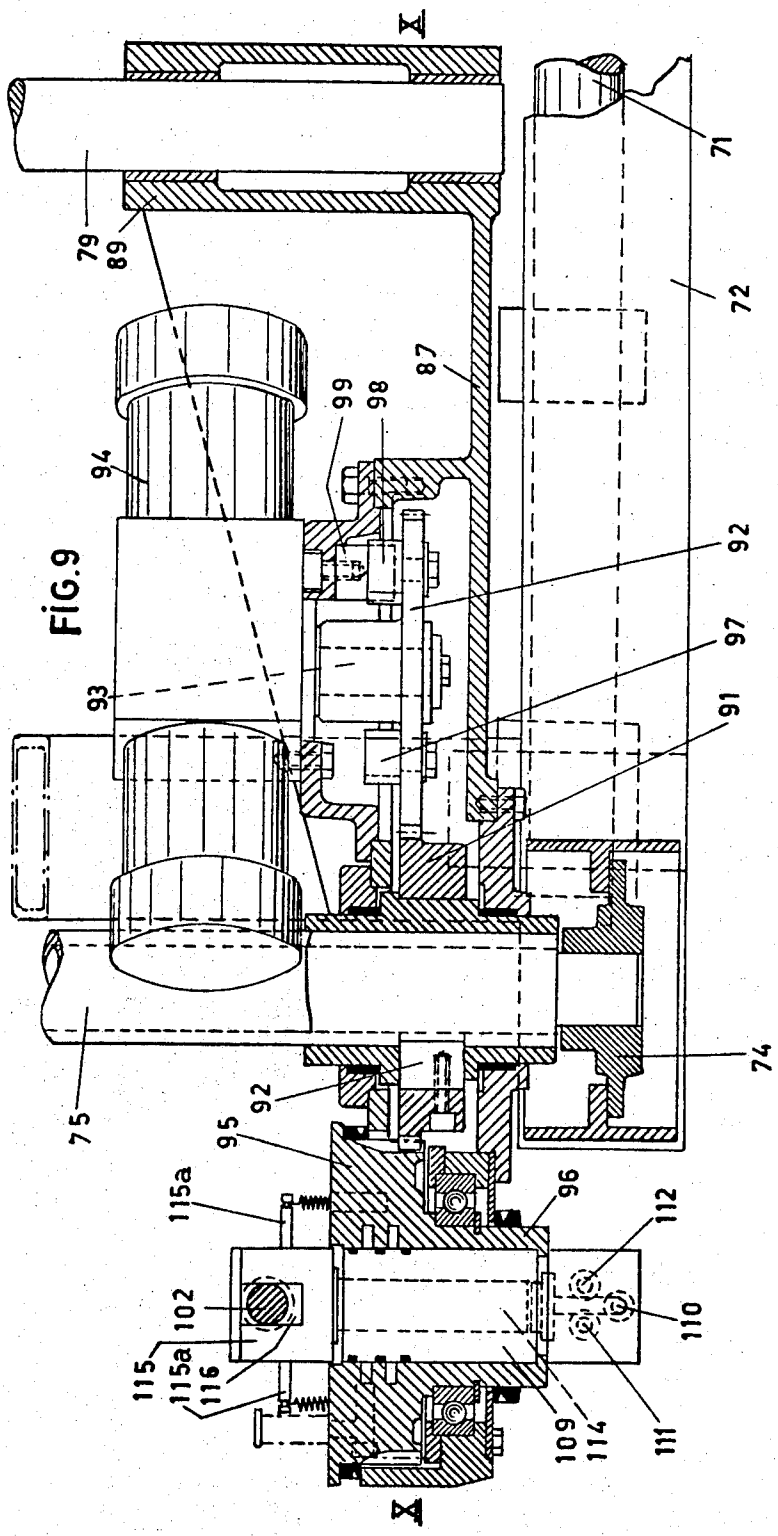

X
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89
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72
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92
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91
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112
115a
102
110
115
115a
116
109
114
111
X

FIG.10

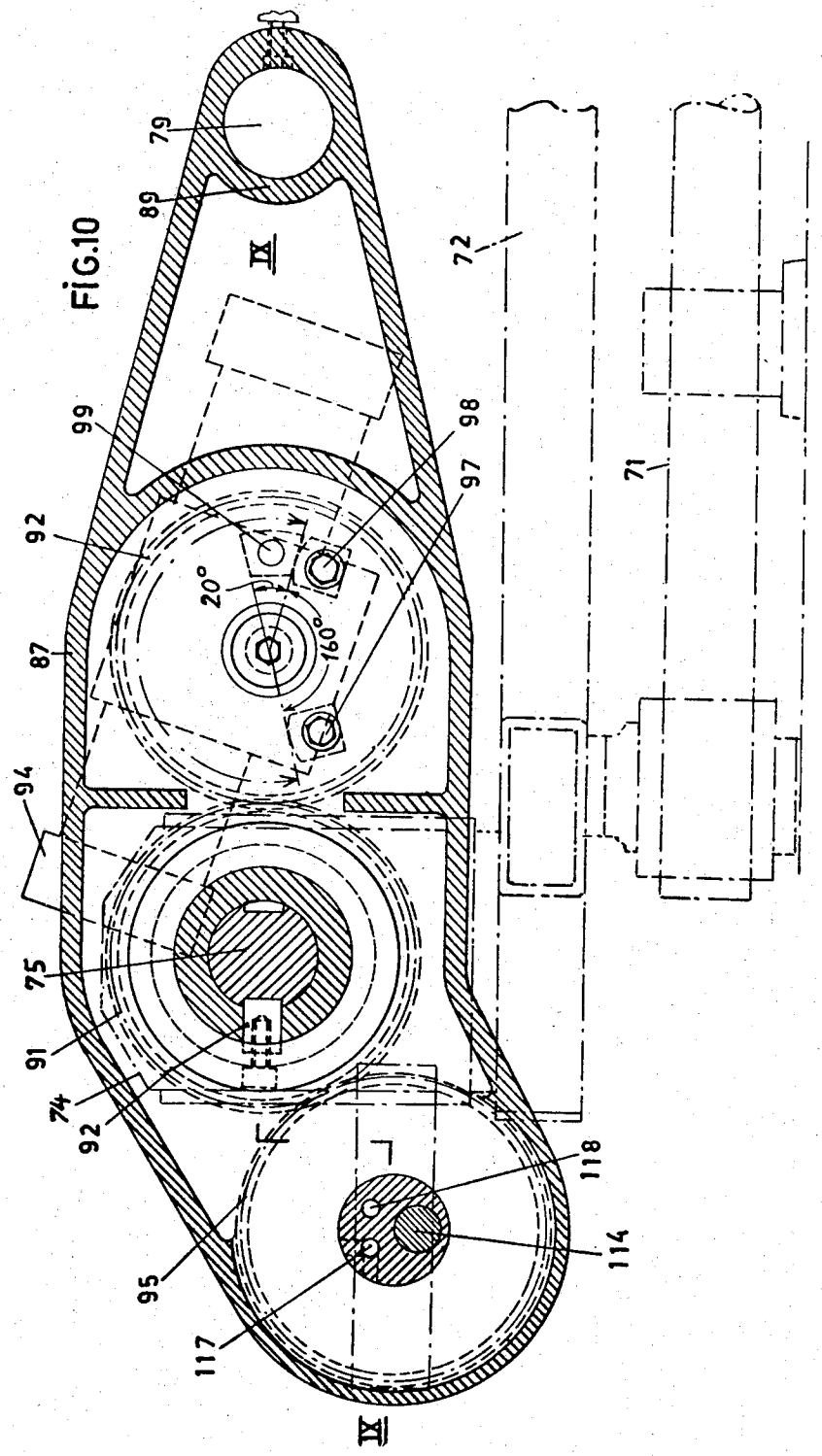


FIG.12

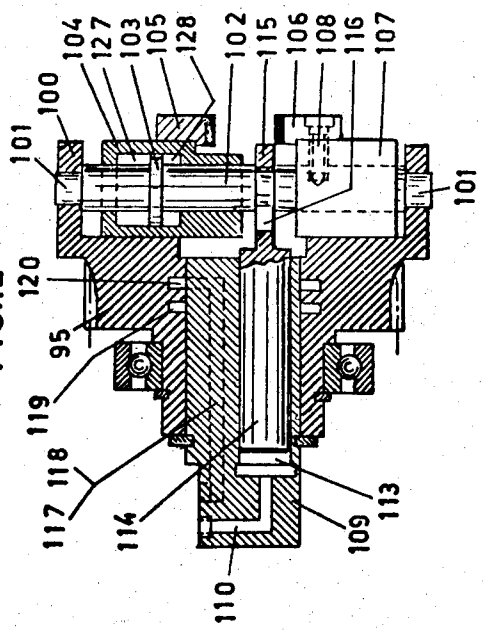


FIG.11

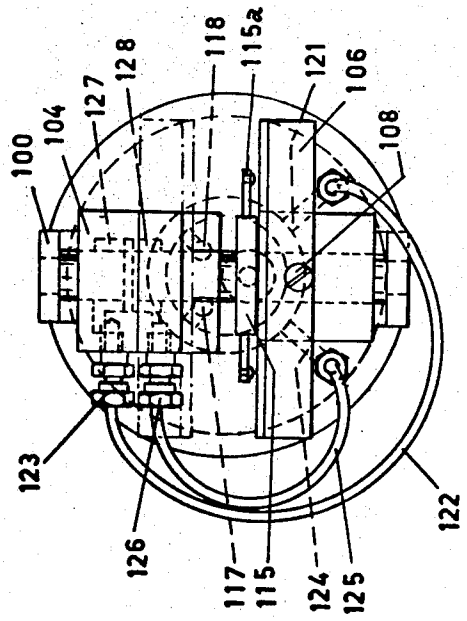
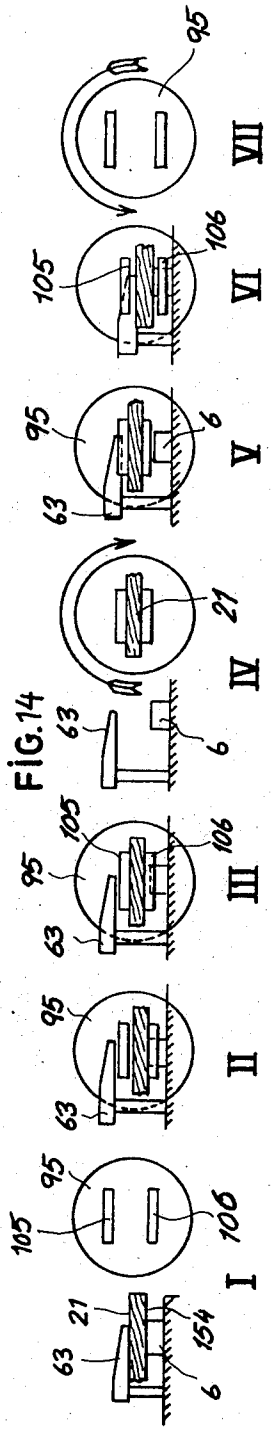


FIG.14



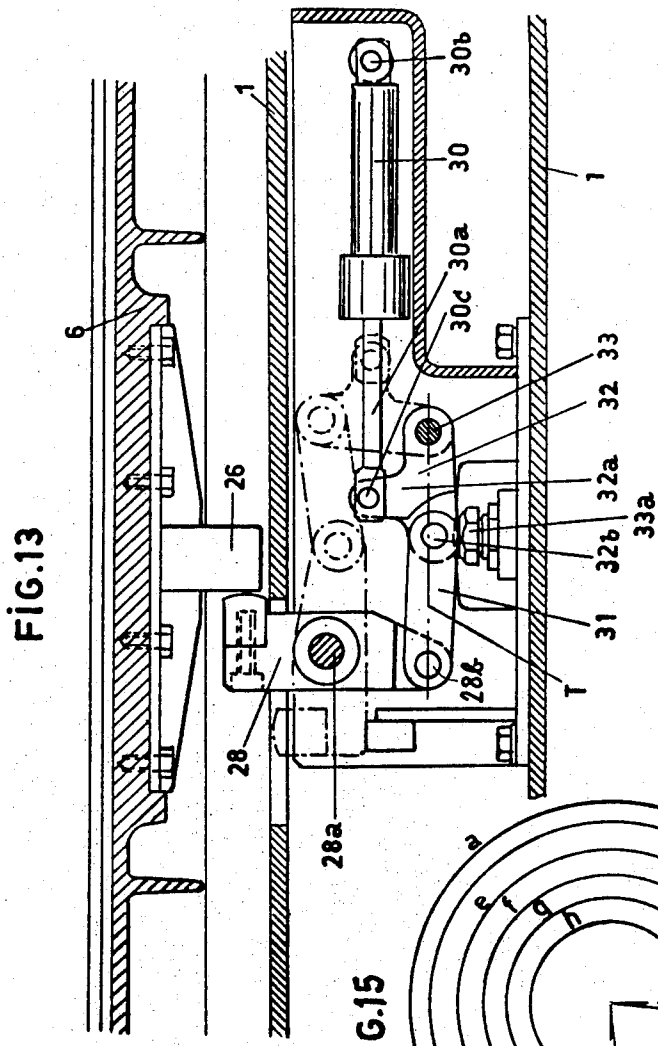


FIG.13

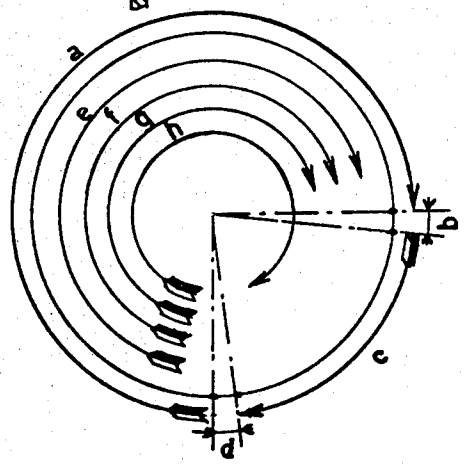


FIG.15

APPARATUS FOR PERFORMING A SERIES OF OPERATIONS ON A SUCCESSION OF WOOD WORKPIECES

SPECIFICATION

1. Field of the Invention

The present invention relates to an apparatus for and method of shaping a workpiece. More specifically this invention concerns an apparatus for the serial production of shaped wooden pieces useable, for instance, in furniture manufacture.

2. Background of the Invention

In the serial production of furniture pieces each workpiece or blank must be shaped and treated in several different manners. These operations can be subdivided into two main categories: longitudinal working and transverse working, relative to a direction of workpiece travel in which the workpiece is usually oriented. For instance, milling machines and sanders usually run longitudinally of the workpiece, while borers and end cutters work transverse to this direction.

As a general rule the workpieces are displaced continuously along a transport path with the longitudinally working machines being fixed and the transverse working machines travelling on carriages along with the workpieces for a short distance. It is extremely difficult to set up and operate such a line since the rate of feed of some of the machines is often inherently greater than that of others so that corresponding adjustments must be made or a lower-quality product must be accepted. It has been considered extremely difficult to make any other type of serial production work.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide an improved method of an apparatus for shaping or similarly working a succession of workpieces, the term "shaping" being used generically to refer to any working operation altering shape or appearance.

Another object is the provision of an apparatus which effects the rapid and efficient shaping of a succession of workpieces which allows each machine along the line to function at the rate to which it is most particularly adapted.

SUMMARY OF THE INVENTION

These objects are attained according to the present invention in an apparatus wherein a train of carriages is displaced stepwise along a working guide or trails along which are arranged a plurality of shaping machines such as borers, sanders, milling machines, and the like. A return guide coextensive with the working guide is arranged thereunder and at both the upstream and downstream ends there is provided an apparatus for removing a carriage from the one end of one guide and thereafter transferring it to the other guide. Each carriage is provided with clamping means for retaining a work-piece, and means is provided for laying a workpiece blank on the carriage at the upstream end of the working guide and for removing a shaped workpiece from the carriage at the downstream end of the working guide.

According to a feature of the present invention each guide track is a pair of parallel round-section rods on which the carriages slide. The means at the ends for transferring carriages from one guide to the other are two pairs of such guide rods spaced apart at the same distance as in the guides and simultaneously registrable with the ends of both guides so that rotation about an axis parallel to the necessarily parallel guide rods can permit a workpiece which is slid off the working guide and onto the upper set of guide rods of the transferring means can be slid off onto the return guide after 180° rotation of the arrangement. This advantageously causes the empty carriage to be returned to the loading or upstream end of the working guide upside down so that any wood shavings or the like are automatically dumped off.

According to another feature of this invention, means is provided along the working guide track to turn over the workpieces as they are stopped alongside it. This means has a pair of arms each provided with a pair of jaws and means for displacing it toward and away from the workpiece and for closing and opening the jaws as well as rotating them through 180°. In this manner the arms are advanced and the jaws are closed to grip the workpiece, then the arms are raised and the jaws are rotated through 180°. Thereafter the arms are lowered, the jaws opened, and the arms withdrawn.

The interval between cycles is determined by the longest individual working step, that amount of time needed for the slowest machine along the line to complete its particular operation, plus sufficient time to displace the carriages. In reality a nominal amount of time is spent displacing the workpieces in comparison to the amount of time spent actually working them. In addition, means is provided for immobilizing the entire train during the actual simultaneous shaping operations with each carraige held rigidly either sandwiched between two other cars or abutting one other car and a stop provided on the machine, which stop is only removed from the carriage's path during displacement of the carriages. This positive immobilization means that extremely accurate preparing of the workpieces is possible, since each workpiece is rigidly held on the bed of an immobilized carriage.

DESCRIPTION OF THE DRAWING

The above and other objects, features, and advantages will become apparent from the following, reference being made to the accompanying drawing in which:

FIGS. **1***a* and **1***b* are side views of the apparatus according to the present invention;

FIGS. **2***a*–**2***c* are top views of the same apparatus;

FIG. **3** is a side view of the arrangement for laying workpiece blanks onto the upstream end of the working guide track;

FIG. **4** is a vertical longitudinal section through arrangement for transferring a carriage from one guide track to the other;

FIG. **5** is a vertical cross section through the arrangement of FIG. **4**;

FIG. **6** is a vertical cross section similar to FIG. **5** but taken further upstream through the apparatus;

FIG. **7** is a vertical section through the device for turning over the workpieces;

FIG. **8** is a top view of the device shown in FIG. **7** with line VII—VII showing the cut line for FIG. **7**;

FIG. **9** is a horizontal section taken through the device of FIG. **7**, in enlarged scale;

FIG. **10** is a section taken along line X—X of FIG. **9** with line IX—IX indicating the cut line for FIG. **9**;

FIG. 11 is an end view of the inverting head of the device of FIG. 7;

FIG. 12 is a section taken along line XII—XII of FIG. 11;

FIG. 13 is a vertical longitudinal section taken through the apparatus showing the end stop;

FIG. 14 is a schematic view illustrating the method of turning over the workpieces according to the present invention; and

FIG. 15 is a diagram illustrating the operation cycle of the apparatus.

SPECIFIC DESCRIPTION

The apparatus according to the present invention has an elongated frame 1 extending from an input or charging station E at its upstream end to an unloading or output station A at its downstream end. Ten different working or shaping stations I–X are provided along the frame 1, with an inverting apparatus W being provided at its center (see FIG. 2*c*) between working stations V and VI.

The frame 1 comprises an upper working guide track 2 supported on a heavy support beam 4 which also carries a parallel return track 3 lying in a plane below the working track 2. A train of carriages 6 travels from input E to output A on the upper track 2 and in the opposite direction on the track 3. On track 2 the carriages abut one another snugly but on track 3 they are not in direct end-on-end contact with one another. Each carriage 6 is provided at its ends with bumpers 8 for pushing and being pushed by the carriages in front and in back.

As shown in FIGS. 4, 5, and 6 each carriage is stoutly made as a heavily ribbed casting provided with bushings 7 that ride on the parallel horizontal rods 2*a* that constitute the track 2. Each rod 2*a* is screwed via a spacer 5 to the flanges of the support beam 4, as is each rod 3*a* of the track 3. These bushings 7 embrace around a major arc, over 180°, of the rods 2*a* and 3*a*, here 270°, so that an extremely firm mounting of the carriage is obtained.

Provided at the downstream end of the working track 2 is a transfer and inverting device 10 and a similar device 9 is provided at the upstream end. The device 10 serves to take a single carriage off the track 2, turn it over, and place it on the track 3 while the device 9 transfers a carriage from the track 3 to the track 2. FIGS. 4 and 5 show the construction of the device 9, being understood that device 10 is substantially identical. The devices 9 and 10 have carriers 13 and 14 rotatable about respective axes 11 and 12 parallel to the track rods 2*a* and 3*a* and equispaced therebetween on respective stands 18 and 23. More particularly, the device 9 has a pair of upper rods 15 and lower rods 16 which register with the rods 2*a* and 3*a*. The upper rods 15 are bolted to the upper flanges of the carrier 14 with interposition of spacers 15*a* and the lower rods 16 are bolted with spacers 16*a*. Motors 14*a* and 15*a* of the so called Kuaxrotor type are provided to rotate the bodies 13 and 14 so that a carriage 6 which has ridden from one of the tracks 2 or 3 onto one of the sets of rods 15 or 16 can then be aligned with the other track and slid off thereon. Of course the carriage 6 is always empty at this point, the inversion at the downstream device 10 serving to dump any sawdust or shavings off the carriage's bed.

In order to maintain the train 6 of carriages in tight contact with one another an advancing cylinder 17 is provided at the upstream end of the device mounted on the stand 18 for the upstream transferres 9. This cylinder 17 can be hydraulic but is advantageously operated by compressed air so that the bumper 20 carried on its piston rod 19 can engage the bumper 8 of a carriage on the transferres and push it off onto the working track 2, simultaneously advancing all of the carriages 6 by a distance equal to the longitudinal length of one carriage. The bumper 20 advances with a progressively increasing acceleration in the space between two working periods, as will be described below. Another fluid-operated cylinder 22 is provided on the stand 23 at the downstream end of the frame 1. The bumper 24 on the piston rod 25 of this cylinder (FIG. 1*b*) is engageable with the bumper 8 on the downstream face of the furthest downstream carriage 6. This cylinder 23 is pressurized to resist advance of the carriage train by the cylinder 17 so that a slow and uniform acceleration and subsequent deceleration of the carriages is obtained.

FIGS. 1*a* and 13 show devices provided at the upstream and downstream ends of the track 2 to hold the train of carriages in place as the piston rods 19 and 25 are withdrawn so that the units 9 and 10 may rotate through 180° to bring a new carriage down or up. To this end each carriage 6 is provided in the middle of its underside with an abutment 26 of heavy construction. At the upstream end a stop 27 which can, as seen in FIG. 1*a*, only pivot in the counterclockwise direction from the illustrated position, to which it is returned by a spring, engages against the upstream face of the abutment 26 of a carriage which has been pushed past it so that this carriage cannot be displaced back upstream. At the downstream end the more complicated arrangement shown in FIG. 13 is provided which basically comprises a pivotal stop 28 engageable against the downstream face of the abutment 26 of the furthest downstream carriage 6 on the track 2. This lever 28 is pivoted at 21a and is connected through two elements 31 and 32 to a fluid-operated cylinder 30. The element 31 is a simple link pivoted at one end at 28*b* on one arm of the two-arm lever 28 whose other arm is engageable with the abutment 26 and it is pivoted at the other end at 32*b* on a simple third-class lever 32 itself pivoted at 33 and having its center lug 32*a* connected via pivot 30c to the piston rod 30*a* of the cylinder 30 which itself is pivoted on the frame 1 at 30*b*. The cylinder 39 is of the single-acting type and is spring biased into the extended position shown in FIG. 13. In this relaxed, solid-line position the pivot 32*b* lies on an adjustable stop 33*a* below a plane T defined by pivot 33 and pivot 28*b* so that the linkage 31, 32 forms a toggle which will maintain the lever 23 erect to resist pressure against the lever 28. Actuation of the piston rod 30 sufficient to lift the point 32*b* above the plane T will alow the abutment 26 to push over the lever, under the effect of pressure transmitted through the carriage train from the cylinder 17. Thus the cylinders 30 and 17 are simultaneously pressurized and the cylinder 22 depressurized to advance the carriage train one step, with the pressure in cylinder 22 being allowed to build up again for even slowing-down of the train and with the cylinder 30 being depressurized again to cause the stop 28 to swing up. The upstream stop 27 automatically pivots over as an abutment 26 passes over it, then snaps up behind

this abutment to block the train in the upstream direction.

As shown in FIGS. 1*a* and 1*b* the workpiece carriages are returned on the return track **3** by a belt **34** spanned between two driven wheels **35** and **36** and provided with upstanding arms **37** which engage behind the carriages **6** and push them along the track **3** from the unloading station A to the loading station E. The belt or chain **34** is driven continuously at a velocity such that there is always a carriage **6** ready to be loaded into the upstream transferrer **9.** A cylinder **38** equipped with a bumper **39** works with the downstream transferrer **10** to push a carriage off the lower bars **16** and onto the track **3** where it can be caught and entrained by one of the arms **37.** At the upstream end E a piston rod **40** carried on a vertical cylinder **44** serves to prevent travel of a carriage into the transferring device **9** except when the rod **40** is retracted downwardly. In addition a horizontally arranged cylinder **41** has a piston rod **42** carrying a dog **42** pivotal, as seen in FIG. 1a, clockwise only from the illustrated position and normally urged back into the illustrated position and normally urged back into the illustrated position by a torsion spring **43**a. Once the transferrer **9** has turned over so that an empty pair of guide rods **15** or **16** is lined up with the lower track **3** the cylinder **44** is depressurized to unblock the waiting carriage **6** and the piston rod **42** is first retracted to pull the catch **43** back under the waiting carriage and then expanded to push this carriage **6** onto the waiting set of rods **15** or **16.** Thereafter the piston rod **40** is again raised and the cylinder **14** is turned over to allow the piston rod **19** to push this carriage off onto the top guide track, during which operation, of course, another carriage may be loaded onto the lower empty track of the transferrer **9.**

The cylinders **17, 22, 30, 38, 41,** and **44** are centrally controlled by a programmer as will be described in reference to FIG. **15.** They can be pneumatic or hydraulic, and are generally coupled to limit switches which in turn are connected to solenoid valves and the like. Of course it is possible to replace some or all of the cylinders by solenoids or motor arrangements so that no fluid power is used at all. The stop **40,** for instance, could easily be the spring-loaded armature of such a solenoid.

As shown in FIG. 2a the workpieces **21** are treated by milling and grinding devices **45, 46** and **47, 48** which are mounted on the machine frame **1** and which coact with patterns **45***a* and **46***a* in a known manner to shape the edges of the workpieces. These devices travel longitudinally, that is, in the workpiece direction of travel, past the arrested workpieces to shape them. In addition transversely effective shapers such as a pair of saws **49** and **50** for shortening the workpieces as well as a borer **51** and a router **52** are provided also along the working path to further shape and prepare the workpieces **21** as they are advanced stepwise. Since the transversely effective devices and the longitudinally effective devices are arranged to opposite sides of the track **2,** both sides of these workpieces **21** can be worked on simultaneously. The drives for the machines **45–52** are electric motors shown at **53–60** respectively. The longitudinally working machines **45–48** are mounted on a common carriage **61** controlled by a cylinder **62** extending parallel to the track **2** which serves to reciprocate them past the stopped workpieces. During return opposite to the transport direction the tools of the machines **45–48** are lifted from contact with the workpieces **21.** Also during this return the clamps **63** holding the workpieces **21** on the furthest downstream carriage **6** are released and this workpiece is pushed off at the unloading end A and the entire workpiece train is advanced one step.

The charging apparatus for loading workpiece blanks onto carriages is shown in FIG. **3** and comprises a slider **145** carried on a beam **146** transverse to the workpiece direction of travel and reciprocal thereon by a fluid-operated cylinder **147.** Each carriage has a bed or surface **154** onto which the workpieces are clamped by the clamps **63.** The slider **145** has two fluid-operated lifting cylinders **148** whose piston rods **149** are vertical and each carry a mounting block **150** in which a vertical carrying rod **151** may slide. This rod **151** is provided with a horizontal pusher bar **152** provided with a catch **153** which pivots from its illustrated position only in the clockwise direction, like the dog **43,** and is returned by a spring. A clamping screw **155** is provided on the body **150** in order to fix the bar vertically therein at a height dependent on the vertical height of the workpieces. These workpieces **21** are stored in a magazine **164, 165** which is open at the bottom. The lowermost workpiece always rests on a support **164***a* just above the level of the pusher **152.** When the bar **152** is moved from left to right, as seen in FIG. **3,** the bottommost workpiece **21** is slid horizontally out of the magazine and over the surface **154,** whereupon the cylinders **148** are relaxed to drop this workpiece down onto the surface **154** and then the bar **152** is withdrawn, the dogs **153** pivoting over as they pass back under the stack of workpieces in the magazine.

The workpieces, once fully shaped, are unloaded from the apparatus at the station A by means of a pair of arms **136** carrying a slider **137** in turn provided with a pair of pushers **139** which engage the workpiece and, under the force exerted by a cylinder **138,** push it off onto a tray **140.** A conveyor **141** next to this tray receives the finished workpieces and carries them off to an assembly station.

It is necessary to turn the workpieces over after they have passed through shaping stations I–IV in order that longitudinally working devices **127–30** reciprocal by a cylinder **142** as well as transverse operators **131–133** may finish the workpiece. To this end the apparatus for turning over the workpieces shown in FIG. **2c** generally and in detail in FIGS. **7–12** is provided at an inverting station W between stations V and VI in which working machines **134** and **135** are provided. The steps carried out by the machine are shown in FIG. **14.**

As shown in FIGS. **7–12** the turning-over device comprises two parallel round rods **71** extending horizontally and normally to the track **2** and supporting a horizontally slidable support frame **72** equipped with sliding bushings **73** so that it may slide normal to the track **2.** This frame **72** is displaced by means of a fluid-operated cylinder **68** which is mounted on the frame **1** and connected with the frame **72** through a coupling **70** on its piston rod **69.** On ends of the transverse beam of the support frame **72** there is provided a support console **74.** An axle **75** extending parallel to the track **2** is pivotal in this console but axially fixed therein and serves to support rockers **76** formed as lever arms which are spaced from each other with an eye **77** around the axle **75** and with an eye **78** tightly engaging around a rod **79** or the like. The rockers are fixed to the rod **79** by a pin **80.** The arms **76** extend somewhat be-

yond the rod **79** and have on their free ends a bar **81** joining them together. A pneumatic or hydraulic lifting cylinder **82** is connected via a coupling eye **83** to the bar **81.** The piston rod **84** of this cylinder **82** is connected by a coupling **85** with an eye **86** of the frame **72.** Expansion or contraction of the cylinder moves the arms **76** up or down.

A pair of two-armed levers **87** are carried on these rocker arms **76.** Sleeves mount these levers **87** on the pivot axis **75** and a guide bushing **89** permits longitudinal displacement on the rod **79** for each lever **87.** Each lever **87** has a clamp **90** situated at the bushing **89** so as to clamp them on the rod **79** after proper spacing depending on workpiece length. An intermediate gear wheel **91** is mounted on each bushing **88,** this wheel **91** being connected by a key **92** to the bushing **92** and to the axis **75** for joint rotation therewith so that the two gear wheels **91** are linked together. Each wheel **91** meshes on one side with a gear wheel **92** which is connected at its axis **93** with a pneumatic or hydraulic motor **94.** On the other side each wheel **91** meshes with the rotating head **95** carried by its hub **96** on the short end of the two-arm lever **87.** The gear wheel **92** mounted on the motor **94** carries two stops **97, 98** offset by 200° about its axis, with another 20° wide stop **99** being carried on the support so as to limit pivoting of this wheel **92** to exactly 180°. Since all of the gear wheels **91, 92,** and **95** are of identical diameter they will all be able to turn through 180° only. Since both levers **87** are coupled together by the pivot axis **75,** both heads **95** will rotate identically through 180°. Of course several such turning devices could be provided, each, for example, only turning the workpiece through 90°, in order to work more than two faces of a workpiece.

Each inverting head **95** has turned toward the workpiece a fork **100** (FIGS. **11** and **12**) which is bored out to receive small-diameter end portions **101** of a fixed piston **103** whose piston rod **102** extends at right angles to the horizontal rotation axis for the head **95.** A displaceable cylinder **104** is slidable on the piston **103** and is provided with a jaw **105** which coacts with another fixed jaw **106** carried on a support block **107,** secured by means of a screw **108** engaging through a slot in the jaw **106.** This lower jaw **106** is adjusted to lie just at the level of the support surface **154** for the workpiece **21** on the carriage **6.**

Received coaxially in each head **95** is a conducting body **109** having a portion projecting from the lever **87** formed with three connections **110, 11,** and **112** (FIGS. **9** and **10**).

Connection **110** leads to an eccentric bore **113** in the body **109** which receives a longitudinally displaceable piston **114.** This piston has a flat projection **115** turned toward the workpiece which is displaceable between the jaws **105** and **106** and which serves to straighten out a workpiece as it lies on the surface **154** by means of its narrow end. This narrow end **115** is formed with an elongated hole **116** coacting with a groove formed in the piston rod **102** acting as a guide for the projection **115** so that it comes into exact position against the workpiece. Two small rods **115a** extend laterally from the end **115** and tension springs between them and the body **109** serve to pull the piston **114** back into the bore **113.** This piston **114** serves to accurately align the workpiece between the two heads **95** before the jaws are closed on it. Pressurization of the core **113** serves to advance the piston to an extent proportional to the pressure to exactly line up the workpiece.

Both connections **111** and **112** communicate through respective passages **117** and **118** in the body **109** with circumferential canals **119** and **120** formed in the head **95** which are separated by a seal ring and in turn communicate through respective bores **121** and **124** and tubes **122** and **125** screwed into the cylinder **104** at **123** and **126** to pressurize the chambers **127** and **128** to either side of the piston **103.** Thus the jaw **105** can be displaced in either direction relative to the jaw **106.**

With reference to FIG. **14** the inverting mechanism W functions as follows:

I. At the start the workpiece **21** is clamped down by the retainer **63** on the surface **154** of the carriage **6.** The jaws **105** and **106** are open and the heads **95** are spaced from the carriage **6.**

II. The clamp **63** is released and the heads **95** are moved up to the workpiece by means of the cylinder **68.**

III. The jaws **105** and **106** are closed on the workpiece **21** by pressurization of the chamber **127** and the workpiece is lifted off the surface **154** by the cylinder **82.**

IV. Again the cylinder **68** is actuated to take the workpiece away from the carriage **21** and the motor **94** is operated to rotate it through 180° exactly.

V. The cylinder **68** returns the workpiece to above the carriage **6.**

VI. The cylinder **82** lays the workpiece on the surface **154** again and the chamber **128** is pressurized to open the jaws **105** and **106.**

VII. The heads **95** are withdrawn by the cylinders **68** and the motor **94** is operated again to return these heads to their original position.

The workpiece **21** is lined up on its carriage longitudinally by means of the bumpers **115** which operate between steps II and III outlined above. In addition lining-up transverse to the longitudinal or displacement direction is effected by bumpers **67** carried on a cylinder **66** mounted on the front of the inverter below the rod **75.** Similar arrangements **156** and **157** are provided, as shown in FIG. **3,** at the loading station E which are operated by cylinders **158** and **159** to line up the workpieces at the start. Each aligning cylinder **66** is mounted on a flange **65** of the frame **72** and is provided with a clamp **64** for locking it in position therealong.

Such aligning devices are arranged across from the loading device **145–152** (FIG. **3**) as shown at **156** and **157.**

FIG. **15** shows schematically the operating cycle of the apparatus. Arc a of the outer circle represents the period during which the various shaping, boring, milling, sanding, and similar devices work on the workpieces. During the period indicated by arc *b* the retaining devices **28–33** are released to prepare the entire carriage train for displacement. In time *c* the advance cylinder **17** is actuated to push the entire train along by one carriage length. Finally during the period of arc *d* the cylinder **30** is pressurized to again block the train of carriages.

It should be clear from the above that by far the greatest amount of time is spent actually working on the pieces of wood. Approximately 25 percent of the time is spent displacing the carriages, returning the tools to their starting positions, and the like.

Arc *e* shows how long it takes, relative to the other operations, for the devices at the ends of the working paths to change a carriage from one guide track to the other. Arc *f* is the time required to set a workpiece blank into the furthest upstream carriage and arc *g* shows how long it takes to invert a workpiece with the arrangement of FIGS. 7–12. Finally arc *h* shows how long it takes to move an empty carriage from one end of the track **3** to the other, in order to keep the upstream transfer device **9** supplied.

Since once a program and operating cycle is established for the apparatus all the operator need do is keep the magazine **164, 165** for workpiece blanks full, the machine is simple in the extreme. All of these workpieces are always worked on as they lay firmly clamped to solid bases so that an extremely high-quality product is obtained.

I claim:

1. An apparatus for shaping a succession of workpieces, said apparatus comprising:

an elongated working track having an upstream end and a downstream end;

a plurality of carriages displaceable along said working track;

means for advancing said carriages stepwise as a train along said working track from said upstream end to said downstream end with each carriage abutting at least one other carriage;

a plurality of shaping machines spaced along said working track intermediate said ends;

means at said upstream end of said working track for laying a workpiece on a carriage at that end;

means at said downstream end of said working track for removing a shaped workpiece from a carriage at that end;

clamp means on each of said carriages for retaining a workpiece thereon;

an elongated return track extending along said working track between said ends;

means for displacing said carriages along said return track from said downstream end of said working track to the upstream end thereof;

means at the ends of said tracks for transferring a carriage from one of said tracks to the other of said tracks, said tracks being each a pair of parallel rods, said carriages riding on said rods, said means for transferring including a rotatable body at each end of said tracks, each body having two pairs of storing rods simultaneously alignable with both of said tracks, whereby a carriage may ride off one track onto the storing rods of said body, and means for rotating said body and bringing each of its pairs of storing rods into alignment with either track.

2. The apparatus defined in claim **1,** further comprising means along said working track intermediate said ends for inverting a workpiece.

3. The apparatus defined in claim **2** wherein the inverting means includes a pair of arms each having a rotatable head, means on said head for grasping a workpiece, means for lifting said arms with the grasped workpiece, and means for rotating heads through 180° with the lifted grasped workpiece thereby inverting said workpiece.

4. The apparatus defined in claim **3,** further comprising means for advancing said arms up to said workpiece from a position alongside said working track.

5. The apparatus defined in claim **1** wherein said means for transferring further comprises means for turning over the carriages.

6. The apparatus defined in claim **5,** further comprising fluid-operated cylinder means for pushing a workpiece off said body and onto one of said tracks.

7. The apparatus defined in claim **1,** further comprising means for maintaining all of said carriages on said working track in snug contact with one another.

8. The apparatus defined in claim **9** wherein said means for maintaining snug contact between said carriages includes a stop at said downstream end and a stop at said upstream end, and means for operating said stop at said downstream end.

9. An apparatus for shaping a succession of elongated wooden workpieces, said apparatus comprising:

an elongated working track having an upstream end and a downstream end;

a plurality of elongated carriages displaceable along said working track in end-to-end contiguous relationship whereby said carriage forms a longitudinally rigid train extending along said track;

a plurality of wood-shaping machines spaced along said working track intermediate said ends and including means shiftable parallel to said track for imparting longitudinal contours to a workpiece on a carriage disposed opposite one of said machines in accordance with a template, said carriages each being provided with longitudinally spaced clamps for retaining a respective elongated wooden workpiece thereon;

a return track below said working track and extending from said downstream end to said upstream end;

a conveyor engageable with carriages on said return track for displacing same independently of the carriages on said working track;

means for advancing said carriages on said working track intermittently;

means at said upstream end for elevating a carriage returned by said return track to the plane of said working track;

means at said upstream end for feeding individual workpieces onto carriages returned to said working track;

means at said downstream end for lowering carriages from said working track onto said return track; and

means at said downstream end for removing workpieces from the carriages on said working track.

10. The apparatus defined in claim **9,** further comprising means along said working track intermediate said ends for inverting said workpiece, the inverting means including a pair of arms each having a rotatable head and adapted to straddle the ends of a workpiece juxtaposed therewith; means on each head for grasping a workpiece; means for lifting the arms with the workpiece grasped therebetween; and means for rotating said heads through 180° with the workpiece grasped therebetween to invert the workpiece.

11. The apparatus defined in claim **9** wherein the means for lowering said carriages at said downstream end for displacement along said return track includes means for turning the carriages over.

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